

Construction and Operation of a Simple Homemade Radio Receiving Outfit

The 1922 Bureau of Standards publication, *Construction and Operation of a Simple Homemade Radio Receiving Outfit* [1], is perhaps the best-known of a series of publications on radio intended for the general public at a time when the embryonic radio industry in the U.S. was undergoing exponential growth.

While there were a number of earlier experiments with radio broadcasts to the general public, most historians consider the late fall of 1920 to be the beginning of radio broadcasting for entertainment purposes. Pittsburgh, PA, station KDKA, owned by Westinghouse, received its license from the Department of Commerce just in time to broadcast the Harding-Cox presidential election returns. In today's world where instant global communications are commonplace, it is difficult to appreciate the excitement that this event generated.

News of the new development spread rapidly, and interest in radio soared. By the end of 1921, new broadcasting stations were springing up all over the country. Radios were selling faster than companies could manufacture them. The demand for information on this new technology was almost insatiable. The Radio Section of the Bureau of Standards provided measurement know-how to the burgeoning radio industry as well as general information on the new technology to the public. Letters to the Bureau seeking information on radio technology began as a trickle, and then soon became a flood. Answering them became a burden.

Circular 120, published in April 1922, began: "Frequent inquiries are received at the Bureau of Standards for information regarding the construction of a simple receiving set which any person can construct in the home from materials which can be easily secured. This publication has been prepared to meet these inquiries." The circular also noted that the Bureau was cooperating with the Bureau of Markets and Crop Estimates of the Department of Agriculture. In the early days of radio, broadcasts to farmers of crop price reports were an important public service.

In 1921 factory-made radios were very expensive. Many of them cost more than \$2000 in today's dollars, and less affluent families could not afford to have one. When the Bureau published this circular (which sold for only five cents) on how to build a simple crystal radio at home, it was an instant success. Thousands of orders

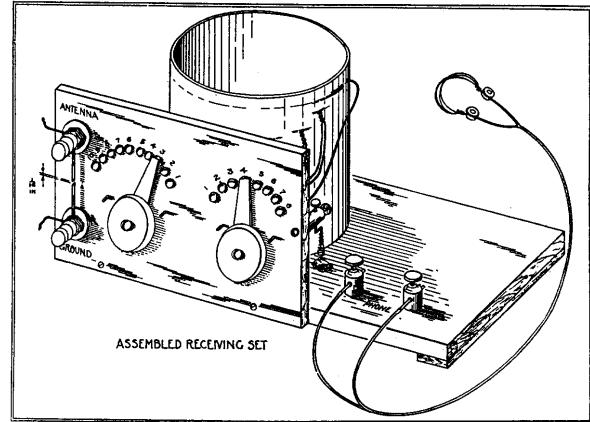


Fig. 1. The crystal radio described in Circular 120.

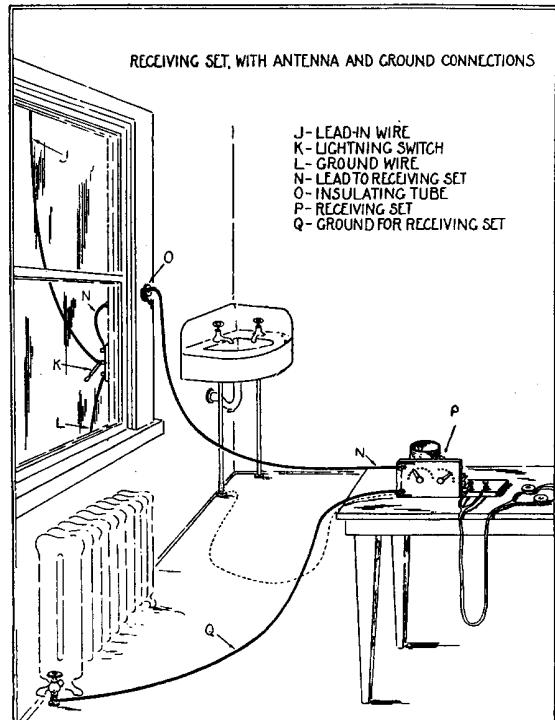


Fig. 2. Diagram showing the antenna and ground connections to the radio.

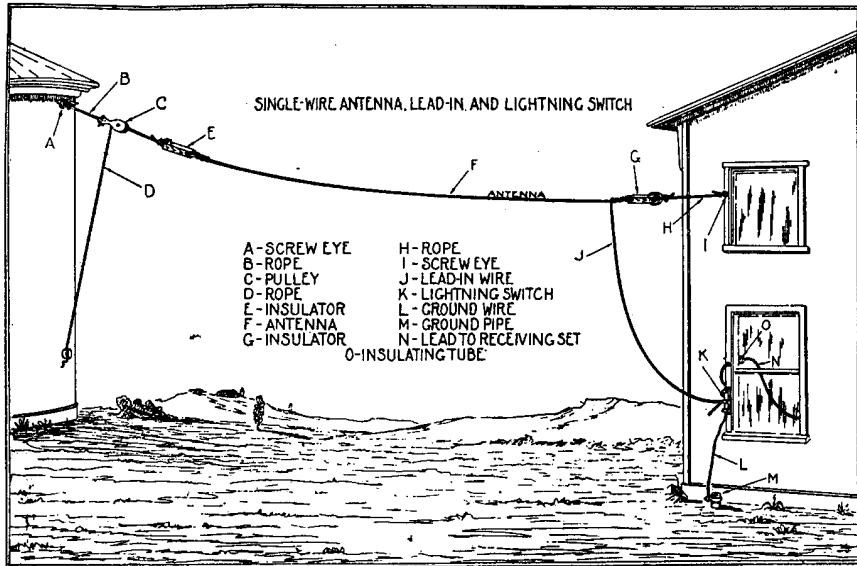


Fig. 3. Details of the outdoor antenna recommended for use with the crystal radio.

flowed in from every state. The circular showed how almost any family having a family member handy with simple tools could make a radio. The circular states "Satisfactory results have been obtained from sets constructed according to these instructions by persons having no previous experience with radio." The authors stated that the cost of the materials for the radio and associated headphones and antenna system should not exceed \$10.

Newspapers around the country urged readers interested in radio to order a copy, and in many cases they reprinted the entire article. Even today, antique radio collectors searching attics and basements often come across dusty home-built crystal radio sets that were obviously constructed using the Bureau's plans. No doubt the remarkably rapid growth of the radio industry in the U.S. during the 1920s (analogous to the growth in Internet-related businesses today) was aided considerably by information provided to the public by the Bureau, such as this circular and the other items noted in the bibliography [2-6].

Circular 120 proved such a success that the Bureau published a number of other circulars on radio technology intended for the general public, as noted in the bibliography. All were popular. In some cases, commercial radio manufacturers copied the circuits proposed by the Bureau. During the same era, other radio publications of the Bureau captured public attention as well, though perhaps in smaller quantities than Circular 120. *Radio Instruments and Measurements* [7], Circular 74, published first in 1918 with a second edition published in 1924, became a best seller in the

post-WW I era. Its principal authors were most likely J. H. Dellinger, J. M. Miller, F. W. Grover, and G.C. Southworth. The authors of Circular 120 are not stated, but some of those same individuals likely contributed to it. J. Howard Dellinger's story is particularly interesting. He came to the Bureau in 1907 as a laboratory assistant at \$900 per year, and retired as Chief of the Central Radio Propagation Laboratory in 1948. He headed the Radio Section for much of its existence. Appendix D of Reference [9] is a biography of Dellinger.

The Principles Underlying Radio Communication [8], Signal Corps Radio Communication Pamphlet No. 40, published in 1919 and issued in a revised edition in 1922, is another interesting example of a popular radio book. Written by the Bureau of Standards for training Army Signal Corps officers, it was an expanded and updated version of Circular 74, noted above, but was also widely used by college students and others studying radio. In spite of the "pamphlet" designation, it was actually a 600-page book. Thomas Edison said "... This is the greatest book on this subject that I have ever read, and I want to congratulate you and your Bureau on its production."

While the general public was interested in radio information for the lay person, the fledgling radio industry needed in-depth technical assistance from the Bureau, which it got. The Bureau helped radio manufacturers make better measurements for quantities such as resistance, capacitance, voltage, and frequency. Results of Bureau research on antennas and radio wave propagation, direction finders, vacuum tube characteristics, and testing were eagerly utilized by major

companies such as General Electric, Westinghouse, Western Electric, and RCA, as well as by a myriad of small radio companies no longer in existence. At the same time that the Bureau was providing information to people constructing radios on their kitchen tables, Radio Section staff members were presenting technical papers on radio at conferences and in journals such as the *Proceedings of the Institute of Radio Engineers*. A good example of the latter is the classic work by John Miller, who discovered and explained “the Miller effect”—a feedback effect in triode vacuum tubes that limited their ability to amplify at radio frequencies [9].

Circular 120 described in detail not only the crystal radio itself but also how to construct an antenna and ground system. To minimize the cost, the circular suggested winding the tuning coil on a discarded cylindrical oatmeal box. For years afterwards, home experimenters used oatmeal boxes as coil forms for homemade radios. The crystal radio did not require batteries, but it did require the user to purchase a commercially made set of headphones (or telephone receivers as they were called in those days), since that accessory was not suitable for home construction.

One can just imagine the thrill of a farm family that had never heard a radio broadcast before trying the new set for the first time, and one of the family members crying out, “Come listen! I am hearing something!” The electronics revolution was underway and the Bureau played a significant part in accelerating the new technology.

Prepared by Brian Belanger.

Bibliography

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